8. Conclusions

The following tables set out the Site Danger Factor results by Road Controlling Authority. In the case where multiple parties have a responsibility the site has been included in the results for the organisation with the dominant responsibility.

8.1 Comparison of Sites Grouped by Road Controlling Authority

The results summarised below represent the outcomes of the randomly selected sites based upon the team's observations and subsequent calculation of the Site Danger Factor (SDF). No particular Road Controlling Authority (RCA) was targeted in the process.

South Island

Authority	Safe	Marginal	Serious	Dangerous	Mean SDF	SDF Range	Total
RCA 1		4	2	7	2340	15 - 6000	**13**
RCA 2				1	6700	6700	**1**
RCA 3		2		1	917	125-2750	**3**
RCA 4		2	1	3	1850	45 - 4000	**6**
RCA 5		5	3		809	25 - 2000	**8**
Total	**0**	**13**	**6**	**12**	**1877**	**15 - 6700**	**31**

North Island

Authority	Safe	Marginal	Serious	Dangerous	Mean SDF	SDF Range	Total
RCA 6		1		5	3371	125-5500	**6**
RCA 7		4		3	2250	50 - 5700	**7**
RCA 8		1	2	1	2001	5 - 6000	**4**
RCA 9		1		3	5988	500 - 14800	**4**
RCA 10			2	5	4571	470 - 13800	**7**
Total	**0**	**7**	**4**	**17**	**3652**	**5 - 14800**	**28**

By the very nature of the audit, some sites have been assessed in a condition that does not necessarily reflect their overall condition throughout the life of that site.

For instance a number of sites were assessed in an unattended condition which could

affect their assessment.

Another factor is the assessment system itself which is still in a state of development and should not be regarded as an absolute indicator of one site's condition when compared with another. However as stated in the executive summary the opinion of the team members was that the figures generally gave a fair representation of the condition of each site.

As can be seen from the above figures the results of the survey clearly indicate substantial problems in the area of temporary traffic control at work sites. Furthermore the two tables demonstrate that the problems are not isolated to any single area.

It is also interesting to note that there is a definite difference in the results between the two surveys (although both show unacceptably high levels of non compliance). This difference could be because the two teams operated independently and were composed of different personnel leading to different interpretations (although two of the team members were common to both surveys). Alternatively there could well be a genuine difference in the level in compliance. Other factors influencing the interpretation of the compliance of the sites could be the complexity of the situations being encountered and possibly higher traffic volumes in the Auckland audit which would affect the outcome of the site danger factor calculations.

The main trend identified was that in the opinion of the both audit team leaders there appears to be a general lack of compliance with the currently available standards with no particular area that could be found to either generally comply or not comply.

Additionally the standard of traffic control provided was extremely variable with the only commonality being that no sites were observed in a wholly satisfactory condition.

However, it is the opinion of the Author, that the '**Satisfactory**' category applied (SDF of 0) is setting an unduly high standard of acceptability.

13 sites out of 31 (ie 42%) in the South Island survey and 7 out of 28 (ie 25%) in the North Island were found to be in the adjacent '**Marginal**' category. It is possible that a number of these would not cause any greater degree of hazard to either the road worker or road user either directly or indirectly because of the deficiencies identified.

8.2 Particular Areas of Non Compliance

The more prevalent examples observed are summarised below:

- **Site Length**
- **Speed Restrictions**
  - Need for Speed Restrictions
  - Level of Compliance of Speed Restriction Reinstatement Signs at End of Site
  - Level of Compliance of Intermediate Speed Restriction Signs
  - Level of Use of 'Temporary' Supplementary Plates Under Speed Restriction Signs

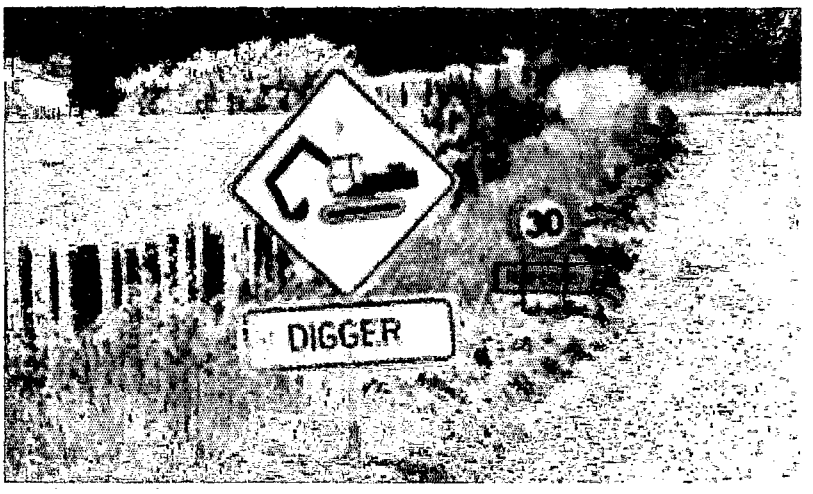
8.2.4.4 Use of non gazetted signs

The use of 'non gazetted' signs means that in a legal sense there is no 'message' being legally conveyed to the road user where one of these signs is used. Similarly a court of law cannot recognise these signs. The purpose of using a regulated series and arrangement of signs is twofold:

1. To provide legal support to message being conveyed.
2. To provide consistency and uniformity to the arrangements and signs being used

In addition, to temporary speed restriction signs with no temporary supplementary plates attached already identified, a further 26 non gazetted signs were noted in use on 11 of the sites in the North Island.

In the South Island 6 non gazetted signs were noted in use on 5 of the sites.



Non gazetted 'Digger' sign

8.2.4.5 Condition of signs

This was assessed used the American Traffic Safety Standards Authority (ATSSA) guide for 'Quality Standards For Work Zone Traffic Control Equipment'

Of 201 signs inspected in the North Island only 5 were in 'unacceptable' condition. This is a generally acceptable result.

The condition of signs was not reported in the South Island survey.

8.2.4.6 Sign positioning too low and too close together and too close to work site.

The North Island survey identified that of the 40 approaches inspected with signs some 21 had signs which were either too closely spaced or too close to the start of work area.

The South Island survey identified 25 signs that were either too closely spaced or too close to the work area.

8.2.4.7 'Crying wolf' through the use of inappropriate signs

Some 40 signs were noted giving an inappropriate or unnecessary 'message' to the road user in the North Island survey. In the South Island 15 signs were so noted.

A frequent cause of this was signs being left in place presumably after the work they were warning of had been completed. One example noted was an unattended site with flagman warning signs still in place.

8.2.4.8 Lack of use or inappropriate use of 'Works End' or 'Thank You' signs

Of the 40 exits inspected in the North Island survey, where advance warning signs had been installed, 33 had no 'works end' or 'thank you' signs, 5 had suitable signs present, but these were located on the right side of the road.

In the South Island 70 exits with advance warning signs were inspected, 51 had no 'works end' or 'thank you' signs whilst 12 had suitable signs present, but these were located on the right side of the road. Three exits were correctly signed with 'works end' signs but had no advance warning signs. One exit used both the 'works end' and 'thank you' signs as a combination on a single stand.

8.2.4.9 Lack of use of RG 19 and 20 (single lane priority signs) where TW 27 (road narrows) signs and uncontrolled single lanes had been implemented.

Single lane operation without traffic prioritising signs. 'Road Narrows' sign also shows wrong side narrowing.

8.2.5 Site Delineation

Again the problems identified here were extensive and covered a number of deficiencies as listed below:

- **Mobile Closures**
- **Approach Layouts**
  - Parked vehicles and other obstructions obscuring signs (South Island only)
  - Signs omitted
  - Side roads not signed
  - Use of non gazetted signs
  - Condition of signs
  - Sign positioning too low and too close together and too close to work site
  - 'Crying wolf' through the use of inappropriate signs
  - Lack of use or inappropriate use of 'Works End' or 'Thank You' signs
  - Lack of use of RG 19 and 20 (single lane priority signs) where TW 27 (road narrows) signs and uncontrolled single lanes had been implemented.
- **Site Delineation**
  - Lack of RG 17 (white arrow on round blue background) signs on the infrequent occasions where lane delineation had been installed
  - Cone tapers either non existent or too short
  - Edge and lane delineation at best poor where it was required
  - Use of permanent edge marker posts as temporary delineation devices
  - Spacing of delineation devices.
  - Use of 44 gallon steel drums.
- **Safety Zones**
- **Protection of Excavations**
- **Protection of Pedestrians**
- **Worker Visibility**

Some of the more dominant areas causing concern are outlined below:

8.2.1 Site Length

In the North Island 7 of the sites exceeded 1 km in length. Four involved seal smoothing operations where the road surface was metal (in 2 cases, clay in part). The longest site assessed was 5.5 km long. In the South Island the longest site was only 800 metres

There is currently no nationally recognised guideline for road works site lengths. The issue of what maximum length of road that should be worked upon at any one time needs to be considered.

8.2.2 Speed Restrictions

Speed restriction sign spacing and position was inadequate on all sites where a temporary speed restriction was in place. In addition the reinstatement of permanent speed restrictions was erratic. In particular in the South Island survey the extensive use of transitional speed limits (ie 100 - 70 - 30) is noted, however the transition

interval was considered to be too short. The South Island team's view was that these were not working and should be replaced with adequately spaced 30 kph approach signs.

This was not reflected in the North Island where only one site inspected used this system. The view arising from this survey was that speed restriction signing was largely inadequate either through not enough repeater signs through roadworks, or signs not being used where they were required. In addition there were a number of occasions where approach signs were noted to be too close to the site in question.

8.2.2.1 Need for Speed Restrictions

Of the 28 sites inspected in the North Island some 14 were considered to require temporary speed restrictions. Of these, only 1 did not have any restriction signs.

In the South Island of the 31 sites inspected some 20 were considered to require temporary speed restrictions. Of these, 5 received no restriction signs.

The North Island had 2 sites signed with speed restrictions which the team considered to be unnecessary. In the South Island only 1 site was considered to be unnecessarily signed.

8.2.2.2 Level of Compliance of Speed Restriction Reinstatement Signs at End of Site

In the North Island, on sites with established temporary speed restrictions, 43 exits to works were inspected. Of these 37 were found to be deficient (ie only 6 were correct) with either the reinstatement sign on the right (17), no sign present at all (15) and/or the wrong speed shown (6).

In the South Island on sites with established temporary speed restrictions 74 exits were inspected. Of these 63 were found to be deficient (ie only 11 were correct) with either the reinstatement sign on the right (30), no sign present at all (32) and/or the wrong speed shown (7).

As stated above, in the South Island survey 11 exits were found to be correctly signed with the appropriate speed limit reinstatement sign on the left side. Five of these consisted of a permanent sign which happened to be in the right place. Furthermore, in all 5 cases, there were no approach temporary speed restriction signs present to compliment the permanent signs for the opposing traffic flow.

8.2.2.3 Level of Compliance of Intermediate Speed Restriction Signs

In the North Island 9 sites were inspected in which the length of temporary speed restriction exceeded 400 metres, the average spacing between each sign legally placed on the left side of the road averaged 740 metres instead of the specified 400 metres maximum. Of the 49 spaces measured/estimated some 41 exceeded the specified limit given above.

In the South Island 6 sites had temporary speed restrictions exceeding 400 metres. The approximate average distance between signs was 550 metres. Two of those sites had signs correctly placed on the left at intervals not exceeding 400 metres.

8.2.2.4 Level of Use of 'Temporary' Supplementary Plates Under Speed Restriction Signs

Both surveys identified some failure to use 'temporary' supplementary plates under speed restriction signs. This is quantified as follows:

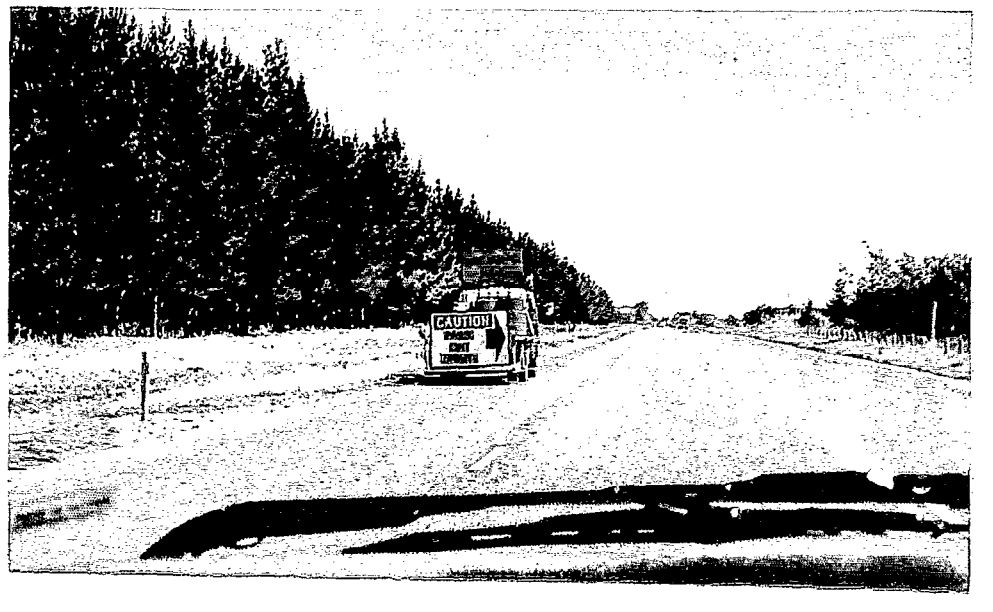
In the North Island 98 temporary speed restriction signs were inspected. Of these 15 were missing supplementary 'temporary' plates whilst 1 plate was noted with a yellow background.

In the South Island 61 temporary speed restriction signs were inspected. Of these 22 were missing supplementary 'temporary' plates. In addition 5 permanent speed limit reinstatement signs were noted with 'temporary' plates.

One of the consequences of the deficiencies in temporary speed restriction signing identified above is that any attempts to enforce the restrictions may well be successfully defended if legal proceeding were instigated.

8.2.3 Mobile Closures

The two mobile closures encountered (Site 12 South Island and Site 12 North Island) also raise a significant issue. Whilst there are undoubtedly areas where the Contractors could improve the operation, the author is of the opinion that the overriding problem is one of a lack of sufficient and suitable standards to cover these works. This is demonstrated by the entirely different equipment used by the two contractors to guide and assist road users past their operations.



Example of mobile closure observed during South Island survey

8.2.4 Approach Layouts

Both surveys identified considerable problems with these. Issues included:

8.2.4.1 Parked vehicles and other obstructions obscuring signs (South Island only)

30 kph sign obscured by power pole

8.2.4.2 Signs omitted

Of the 28 sites inspected in the North Island, 6 had no signs of any kind whilst a further 14 sites were missing signs in areas other than side roads and speed restrictions which are dealt with elsewhere.

Of the 31 sites inspected in the South Island, 5 had no signs of any kind whilst a further 18 sites were missing signs in areas other than side roads and speed restrictions.

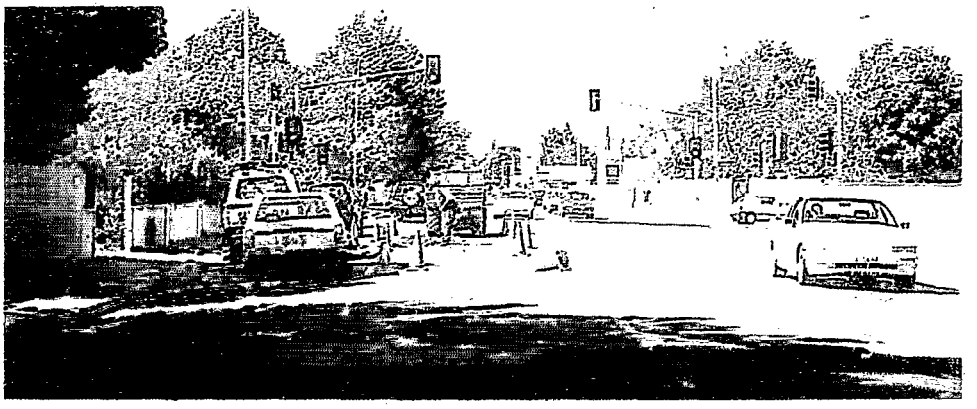
Road works site operating without any signs

8.2.4.3 Side roads not signed.

Of the 23 side roads inspected in the North Island survey only 6 had any signs and many of these were also deficient in some other respect. In the South Island the situation was better with 29 side roads receiving signs out of the 55 inspected. Again however significant deficiencies were noted in the level of signing provided.

8.2.5.1 Lack of RG 17 (white arrow on blue background) signs on the infrequent occasions where lane delineation had been installed.

8.2.5.2 Cone tapers either non existent or too short



Example of closure with no approach taper

8.2.5.3 Edge and lane delineation at best poor where it was required

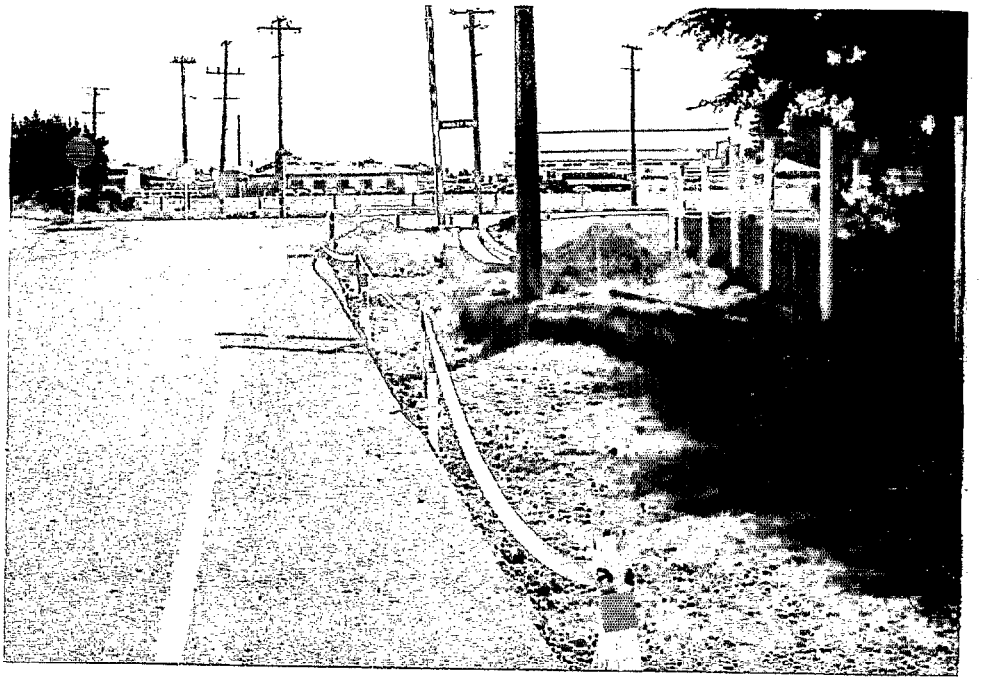
Example of site with no edge delineation or channelising of lanes

8.2.5.4 Use of permanent edge marker posts as temporary delineation devices

Particular note was made of the practice of using edge marker posts to delineate the side of the available road especially where there were significant hazards such as vertical drops (including one vertical drop in excess of 1 metre). Furthermore in the North Island survey it was noted that these had also been modified by casting them into concrete feet (no doubt to increase their stability without the need to drive them into the ground) without any apparent regard to the increased hazard resulting if they were struck by a road user.

In the North Island, of the 28 sites inspected, some 17 required delineation. Of these 8 made some use of appropriate devices, although generally still not meeting the spacing requirements, whilst 3 sites also made use of edge markers posts.

In the South Island, of the 31 sites inspected, some 25 required delineation. Of these 6 made some use of appropriate devices, although generally still not meeting the spacing requirements, whilst 1 sites also made use of edge markers posts.



Example of inappropriate use of marker posts to delineate edge of site. Also note the lack of safety zone and vertical drop immediately adjacent to the live lane

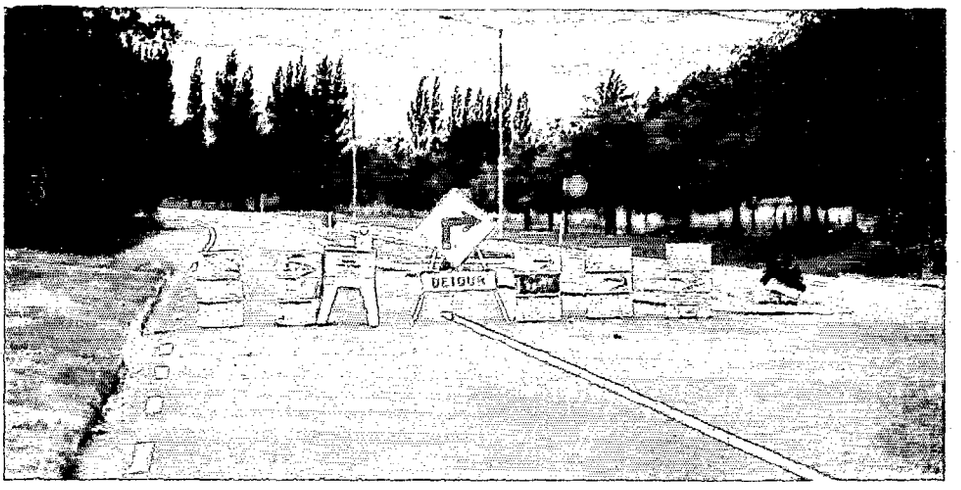
8.2.5.5 Spacing of delineation devices.

Spacing of the devices, where any were present, was generally inadequate with spacings of up to 100 metres being frequently noted.

Example of inappropriate use of edge marker posts and inadequate spacing of devices

8.2.5.6 Use of 44 gallon steel drums

44 gallon steel drums were much in evidence in both surveys despite their well publicised banning by Transit New Zealand a number of years ago.

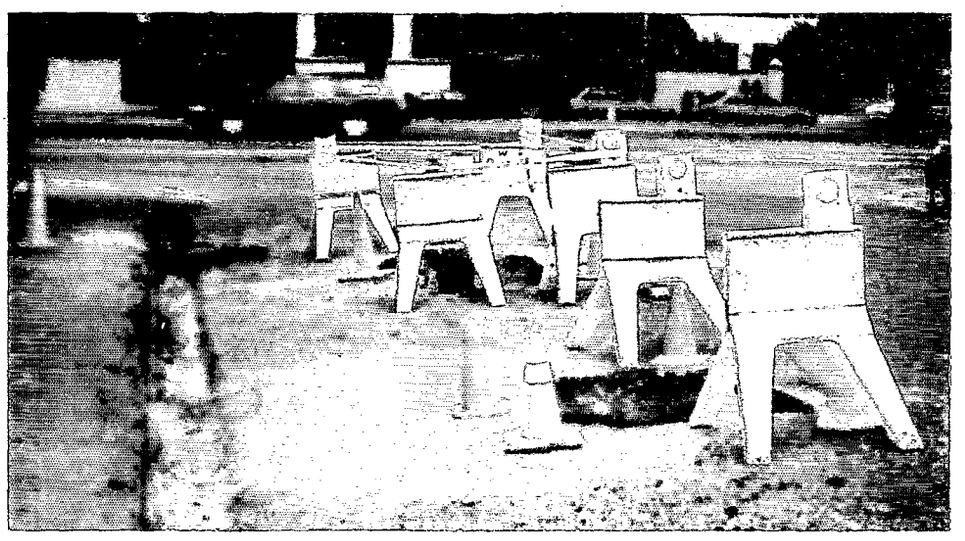


Example of a road closure using steel 44 gallon drums without a 'road closed' sign

8.2.6 Safety Zones

Safety Zones are areas designated where both road users, road workers, equipment (other than traffic control equipment) and materials are excluded. 'Working on the Road' specifies a 1 metre safety zone around the working area within the road works closure

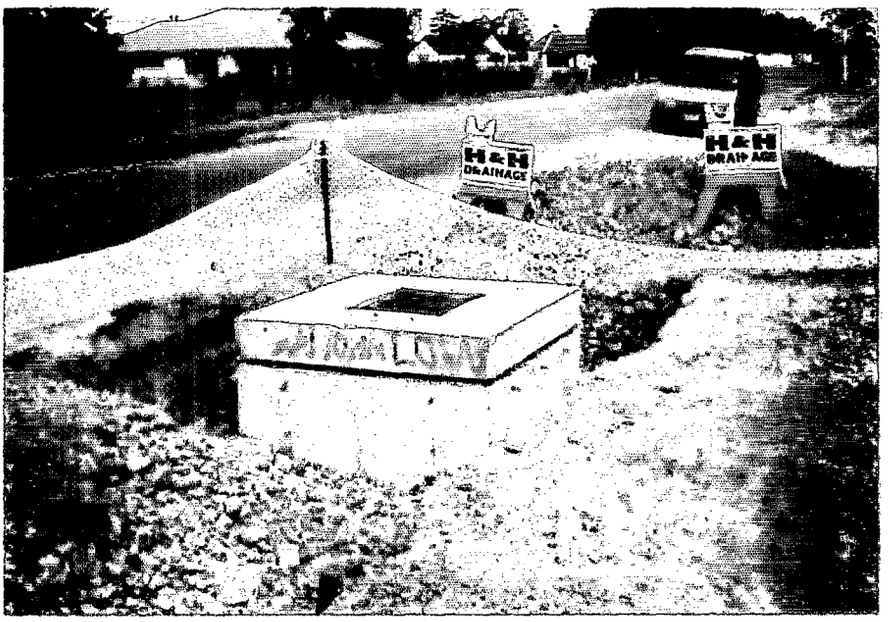
The non compliance with this requirement was also extensive with plant noted being operated in live lanes, materials stockpiled in or adjacent to live lanes and excavations left hard against live lanes. NB a live lane is defined as any lane which is designated for the use of road users at the time of the road works activity.



Example of site with no safety zone

8.2.7 Protection of Excavations

This was an area which considerable concern on both surveys with extensive drops (of over 1 metre in some cases) being noted with limited protection, delineation or safety zones being provided.



Inadequately delineated and protected unattended excavation

8.2.8 Protection of Pedestrians

Where sites were located in urban areas with footpaths and these were affected by the works there was not one site which attempted to provide a secure clearly delineated alternative route. In many cases pedestrians were expected to walk in live lanes to pass the site.

Pedestrians forced to walk in a busy city street without protection because of roadworks on the adjoining footpath

8.2.9 Worker Visibility

This is one area where the two surveys differed significantly. The South Island survey found that a significant number of workers were not wearing any form of high visibility clothing and some which were being worn were in poor condition. In the North Island this was not noted as a problem rather the reverse where only two personnel were noted without the appropriate high visibility garments.

Worker on road without high visibility jacket

8.3 General Conclusions

It would thus appear that the problems are somewhat more fundamental in that whilst certain standards are specified, there is widespread non compliance. This would indicate that satisfactory enforcement of standards is generally not being undertaken.

9. Responses from Affected Road Controlling Authorities

Each affected Road Controlling Authority was notified of the outcome of the audit for their particular roads (ten in total). A total of six responses were received at time of finalising this report.

Of the 5 South Island RCAs, 4 replies have been received, whilst only 2 replies have been received from the 5 North Island RCAs.

The responses received were generally supportive of the principle of auditing temporary traffic management arrangements.

10. Recommendations

The terms of reference (refer Appendix I) require recommendations to be given on the following areas:

- Areas requiring further attention such as significant areas of non compliance;
- Areas where standards and/or legislation require modification;
- The need for further audits and the form that they should take; and
- The development and publication of the audit process

The recommendations made below are based upon the observations and conclusions drawn from the two audits (see Conclusions above) and the author's opinions based upon his understanding and knowledge of the workings of the road construction and maintenance industry and the standards that they are required to work to.

The opinions expressed within this section are the author's and do not necessarily represent those of Transfund New Zealand.

10.1 Summary of Recommendations

- **Areas requiring further attention such as significant areas of non compliance**
  - Commercial restraints
  - Lack of enforcement.
- **Areas where standards and/or legislation require modification**
  - Standards unnecessarily complex:
    - advance warning signs
    - 'works end' signs
  - Standards do not always match legislation:
    - speed restrictions
    - stop/go paddles not gazetted
    - arrowboards not gazetted
    - 'Working on the Road' diagrams may breach traffic regulations
  - Use of supplementary plates confusing.
  - Guidelines for mobile closures confusing
  - Need for a nationally recognised standard which:
    - accurately and appropriately reflects the legislation
    - is financially sustainable by the nation in all areas
    - has sufficient controls in place to enforce the standard
    - provides a regime for mandatory nationally recognised training of relevant personnel to adequate levels.
- **The need for further audits and the form that they should take**

  There is a need for audits at all levels including internal auditing by contractors. In addition the need for night times audits has been specifically identified.

- **The development and publication of the audit process**

  This is currently in progress. The resulting process needs to:
  - reflect current and future standards
  - have transparency
  - be financially sustainable
  - be fair to all parties
  - be relevant to all road situations
  - be consistent in all areas

10.2 Areas Requiring Further Attention Such as Significant Areas of Non Compliance;

Given the extent of non compliance found, as detailed above, it would appear to the author that the causes of the problems identified go beyond a simple failure to comply with accepted standards. To understand the cause it is necessary to consider why such levels of non compliance, as identified, exist.

In the competitive market that road work activities are required, by legislation, to exist there is the temptation to cut corners. This temptation is accentuated by the systems supposedly in place to monitor the standards also being subject to similar competitive restraints.

This situation isn't necessarily a reflection on any particular organisation or component of the industry. It can also be a symptom of the laws of survival where parties either do the work they can afford to do (whether or not it meets the supposedly required standards) or they lose money and ultimately go out of business.

The temptation to reduce standards will increase at times when profit margins are reduced. This is a trend that has occurred for the road construction and maintenance industry since the implementation of the Transit New Zealand Act.

Whilst reduction in prices is, in itself, a desirable goal, it should not be at the cost of erosion of performance to accepted standards which is what appears to have occurred.

10.3 Areas Where Standards and/or Legislation Require Modification;

It is the author's opinion that some of the non compliance observed resulted from the complexity and confusion within and between the current standards and the legislation covering them.

These include:

- The apparent requirement for different advance warning signs for different situations is confusing for both the road worker and road user. A single standard sign should be used for all road work activities irrespective of the status of the site.

  Particularly confusing is the advance warning signage for new chipseal surfaces once the site is complete. The author's interpretation of the Manual Of Traffic Signs And Markings is that a TW2 sign (consisting of a TW1 Advance warning sign with 'Wet Tar' supplementary plate) may be used for 2 to 3 days following completion

of a new coat of seal. However in another section of the manual it states that a TW 19 (which consists of a TW 18 Loose Stone sign with supplementary 'New Seal' plate) should be used. The manual does not advise whether either sign may be used or whether they should be used together. Reference is made to 'Working on the Road', however this document does not clarify the use of these signs any further.

Currently the interpretation that is generally made is that is that the TW1 series should be used only when work is actually occurring and they should be replaced with the loose stone series once the site is left unattended but where the hazard of loose stone remains.

- The standards, detailed in 'Working on the Road', The Code of Practice for Working on High Capacity Highways and the Manual Of Traffic Signs And Markings, relating to the use of temporary speed restrictions are generally clear for the road worker. The same level of clarity is not present in the traffic regulations and the result is confusion over what standards are required.

  The one area which is not covered by any documents is whether or not different speed restrictions may legally exist for the same section of road for opposing flows of traffic.

- The standards pertaining to mobile closures may be unclear and also impractical for certain situations.

- Delineation spacing requirements are confusing and use numbers which difficult to remember. They are also based upon the permanent speed restriction which may not be relevant if a temporary speed restriction has been placed.

- The placement of speed restriction change points must be at the same point for both sides of the road, not as currently shown on 'Working on the Road' which may currently breach the Traffic Regulations. The same comment applies for the placement of Advance Warning Signs and 'Works End' signs.

- Some ungazetted signs observed are clearly practical and indeed, essential in one case, namely the stop go paddle. These need to be included as gazetted signs with full legal implications for the road user.

  Examples include the supplementary plates 'Please Stop on Request' for the traffic controller advance warning sign which encourages courtesy in return from the road user and the 'New Seal' supplementary plate under the loose stone sign which is more relevant than the current 'Wet Tar' which is used under the Roadworks Advance Warning sign. The author is of the opinion that the reference to new seal on both signs would be a more consistent approach.

To rectify the current level of inconsistency and complexity, the following issues need to be addressed:

Standards need to be reviewed at a national level with the goal of achieving a uniform standard for all organisations and individuals both working on and using all roads, variations should only occur where a real change in the nature of the road occurs, local variations without basis must be eradicated.

Currently Transit New Zealand are in the process of producing a single standard to

cover temporary traffic control on all roads that fall under their control (state highways). It is understood that this document once approved would be made available for other road controlling authorities to use at their discretion. A draft for comment was released in December 1998.

Since, as stated above, there is clearly a need for a single national standard, Transit New Zealand is to be applauded for taking the initiative.

However, if the document is to truly form a national standard, then it should be released in the name of a nationally recognised roading organisation with a responsibility for safety. The two organisations which fit this criteria are Transfund New Zealand and LTSA.

However only Transfund has a financial interest in the control of the road network. It is the opinion of the author that there is a need to ensure that a balance is obtained between available funds and the necessity for safety provisions.

The author believes that any standard produced must be capable of being enforced for all roads. Again the only organisation which can proactively enforce standards is Transfund through the approval of funds.

Accordingly, for the reasons given above, it is the author's opinion that the only organisation that should be considered for this role is Transfund New Zealand.

For the standard to be fairly enforceable there also needs to be contractual conditions in some form with absolutely clear requirements for all parties involved. It is the author's opinion that any standard under development needs to be considered with this requisite in mind. These requirements must be provided at the same time as the standard to ensure the non compliance issues outlined above do not continue.

Again from the level of non compliance observed and general comments made by industry representatives, the author is of the opinion that there is a need to be sure that all involved personnel have a sufficient level of knowledge for them to be able to satisfactorily undertake this work.

The standards developed need to deal with this to ensure that a suitable training regime is drawn up **as a requirement** which is matched to the required "level of service" for particular classes of road.

It is the author's opinion that the training programme needs to be nationally coordinated and recognised.

Examples of criteria that need to be considered are:

- Subject matter taught
- Formal assessment process to provide assurance that the personnel do have a reasonable understanding of the information they are being taught including practical aspects, ie they must be able to do as well as understand.
- National recognition of training and assessment processes should also be established as necessary
- Need for training to be mandatory before personnel are able to undertake particular tasks on a work site.

10.4 The Need for Further Audits and the Form that they Should Take

Having addressed the issues of standards and education and training which are essential pre requisites to 'get the job right', the next link in the chain is the need for enforcement.

The procedure used in this audit was based upon that trialled in the 29 January 1997 audit. Again both survey teams found the system to be essentially sound in principle since it impartially gave answers in regard to the level of compliance/non compliance being achieved on each individual site. The answers calculated generally reflected the combined findings of each audit team.

The procedure's particular strengths were that it not only identified the site's deficiencies but also factored in the effect of the site upon the road and the traffic volumes and movements on the road.

10.5 The Development and Publication of the Audit Process

However as with any new process the teams did find a number of areas where improvements could be made. The team leaders have already made some modifications to the system and a trial of the revised calculation procedure is currently in progress in the Transit New Zealand Region 2 area. In the meantime further development work is proceeding. This has included the drafting of audit procedures which are now available as interim safety audit procedures (refer Transfund Report No. RA98/689S). Further work includes training of personnel to undertake further audits fairly and consistently.

The process could be used for assessing road work sites for all purposes including Contractors QA requirements, Site Monitoring by Consultants, Principals and Road Controlling Authorities as well as national or area based audits such as the one currently being reported on.

To conclude, the solutions are to produce a standard which is both affordable by the nation, and practicable and safe for the road worker and road user. Once this is achieved then the standard should be enforced fairly and evenly across the country.

A particular area, noted by the audit teams who considered further work was required, was the question of road work sites after dark. This need is borne out by the Road accident data for road work sites compiled by the LTSA and included in Appendix IV.